PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

DN 51473

In re application of:
Gallagher et al. :

Serial No.: 10/661,051 :

Filed: 09/13/2003 : Group Art Unit: 1765

For: AIR GAP FORMATION : Examiner: Chen, Kin-Chan

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 2313-1450

DECLARATION OF RICHARD R. CLIKEMAN UNDER 37 CFR §1.132

I, Richard R. Clikeman, declare and say that:

1. I am a citizen of the United States.

2. I am employed by Rohm and Haas Company as a Research Patent Liaison, Patent Agent, and Distinguished Scientist. I have a Bachelor of Science degree in Chemistry (1969) from Illinois Wesleyan University. I have a Doctor of Philosophy Degree (1973) in Organic Chemistry, from Northwestern University. I have worked for Rohm and Haas for 33 years, including over 25 years in polymer related fields. During my career at Rohm and Haas, I have worked in the following areas: Chemical Process Research – senior scientist defining scalable synthetic routes to small molecules for agricultural, pharmaceutical, and industrial uses, and scaling up the processes for commercialization (5½ years); Plastics Additives (8½ years) – lead senior scientist defining new impact modifying polymer products, their synthesis, applications, and commercial processes, including two products that have been worldwide leaders in the field for two decades; Corporate Exploratory Research – distinguished scientist pursuing new technology in the fields of rubber modification, binders for injection molded metals and ceramics, membranes, unique acrylic polymer grafts to polyolefins, polymer encased liquid

crystals for electro-optical displays, and synthesis of encapsulated liquid and solid cores including pesticides and many other hydrophobic substances (11 years); Patent (7½ years) – distinguished scientist operating as patent agent, inventor, and patent liaison working with the Emerging Technologies group, and initially with the Coatings group.

3. I am a co-inventor on 5 pending U.S. Patent Applications and on 12 granted U.S. Patents, including 1 patent application and 6 granted patents in the area of cross-linked polymer particles. I have also co-authored 5 papers and publications relating to the field of polymer chemistry.

4. I have reviewed U.S. Patent Application serial no. 10/661,051 ("the Application") and the Official Action dated November 29, 2005 as well as the references cited in the Official Action, Bresling et al. (US 6,562,732), Babich et al. (US 6,815,329), and in particular the Odian reference.

5. The claims in the Application are directed to a method of manufacturing a device comprising the steps of: a) disposing a sacrificial material layer on a device substrate; b) disposing an overlayer material on the sacrificial material layer; and then c) removing the sacrificial material layer to form an air gap; wherein the sacrificial material layer is a cross-linked polymer comprising as polymerized units a multi-ethylenically unsaturated monomer. This instantly claimed process specifically uses a cross-linked polymer, and particularly a cross-linked polymer that comprises as polymerized units a multi-ethylenically unsaturated monomer.

6. The process of Bresling (US 6,562,732) forms air gaps by using thermal degradation to remove a "polymer". See column 4, lines 24-29. The only "polymers" exemplified in Bresling are *linear* polymers. Column 4, lines 3-4, of the Bresling patent only discloses polymethyl methacrylate, polystyrene and polyvinyl alcohol. None of these polymers contain a *multi*-ethylenically unsaturated monomer (i.e. a cross-linking agent) as polymerized units. Each of the polymers disclosed in the Bresling patent contains only *mono*-ethylenically unsaturated monomers (i.e. methyl methacrylate, styrene and vinyl alcohol). As such, the polymers disclosed in the Bresling patent do not contain a cross-linking agent.

7. Polymers used as the sacrificial material in the Babich patent (US 6,815,329) are also *linear* polymers. See column 8, line 57 to column 9, line 8 of this patent which discloses

norbornene polymers, polymethyl methacrylate, polystyrene, polycaprolactone, and polyacrylamide. None of these polymers contain a *multi*-ethylenically unsaturated monomer (i.e. a cross-linking agent) as polymerized units. In fact, the Babich patent specifically teaches that suitable materials for use as sacrificial materials are described in this patent as "low thermal stability versions" of various materials. See column 8, last line, to column 9, line 7. Throughout this patent, the sacrificial material is often referred to as "low thermal stability" material. One skilled in the art reading this patent would be lead to a sacrificial material that had low thermal stability so that it would be easily removed or degraded thermally. This description of low thermal stability materials in the Babich patent is consistent with what is known about linear polymers in general as compared to cross-linked polymers.

8. Apparently, the Odian reference was cited in the Official Action simply to show that polymers come in various forms, such as linear, branched and cross-linked. While this text discusses various types of polymers, such as linear and cross-linked, it also clearly teaches that the different types of polymers have different properties and physical characteristics. More importantly, the Odian reference would clearly lead one skilled in the art to appreciate that different types of polymers are not necessarily interchangeable.

9. Looking at Odian, *Principles of Polymerization*, 3rd edition, pp. 108-109 (1991), submitted by Applicants in their response dated October 24, 2005, quite a few differences between linear and cross-linked polymers can be found, which are summarized in the following table.

Odian's comparison of non-cross-linked and cross-linked polymers

Item of comparison	Non-cross-linked polymer	Cross-linked polymer
gelation	none	yes
solubility	yes, in one or more type of solvent	"The gel is insoluble in all solvents at elevated temperatures under conditions where polymer degradation does not occur."
network	none	"infinite network... macroscopic molecule... one molecule"
physical change during crosslinking from a linear/branched polymer to a crosslinked polymer	"dramatic"	
flow characteristics	"soften and flow when heated"	"infinite viscosity... excellent ***stability toward elevated temperatures*** and physical stress... ***dimensionally stable under a wide variety of conditions*** due to their rigid network structure... ***will not flow when heated...*** thermosetting" (Emphasis added.)

As the comparison in the above table shows, significant differences exist between cross-linked and non-cross-linked polymers. One of ordinary skill in the art reading the Odian reference would understand the differences between cross-linked and non-cross-linked polymers and that such polymers are not necessarily interchangeable.

10. Both the Bresling and Babich patents disclose the need for polymers that can be thermally removable, and in particular, such polymers need "low thermal stability". One skilled in the art reading Odian would simply be lead to use other linear polymers similar to those disclosed in the Bresling and Babich patents, and would not be lead to substitute a *cross-linked* polymer for the linear polymers disclosed in these patents. For multiple reasons, the Odian reference teaches one

skilled in the art to eschew the use of cross-linked polymers in the processes of Bresling and Babich. For example, Odian instructs one of ordinary skill that, as the temperature of the layer of non-cross-linked polymer is increased, the non-crosslinked polymer becomes more and more fluid. One of ordinary skill would be led to believe that, once decomposition begins, any volatile organic vapor created by the decomposition would be able to escape from (i.e., would not build up within) the fluid, low viscosity, layer. Again, in sharp contrast, Odian's teachings regarding flow characteristics of cross-linked polymer indicate that the cross-linked network is structurally *stable* (thermally stable) and infinitely viscous at temperatures below degradation. One of ordinary skill will further know that onset of degradation is not likely to be accompanied by a sudden drop in the structural integrity and viscosity of the network. A likely outcome posited by the reading of Odian would be entrapment of vapors, followed by bubble formation, cracking, and deformation of the layer and surrounding structures. In short, one skilled in the art would expect undesired, if not catastrophic, results to ensue from the use of a cross-linked polymer in the processes of Bresling and Babich.

11. In summary, cross-linked polymers and non-cross-lined polymers (such as linear polymers) have very different physical properties. One important property of cross-linked polymers is their excellent thermal stability. Such a position is clearly taught in the Odian textbook (see the above table). Both the Bresling and Babich patents teach the need for an easily thermally removable polymer. In my opinion, one skilled in the art looking for such an easily thermally removable polymer, particularly in view of the teachings of the Bresling or Babich patents and in view of the teachings in Odian, would <u>not</u> look to a cross-linked polymer. Even if one skilled in the art read the Odian textbook and found that cross-linked polymers existed, such person would <u>not</u> expect, based on the teachings of Odian itself, that cross-linked polymers would work in the Bresling or Babich processes.

12. Undersigned declarant makes this Declaration with the full knowledge that willful false statements herein are punishable by fine or imprisonment or both under 18 U.S.C. § 1001 and may jeopardize the validity of the application or patent issuing thereon. All statements made herein of declarant's own knowledge are true and all statements made on information and belief are believed to be true.

2/28/2006 | Richard R. Clikeman

Date | Richard R. Clikeman